THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

- 1. A lead composition for use in the production of battery components, the lead composition comprising
- lead

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- 20-100 ppm silver
- 250-1000 ppm bismuth, and
- 250-1000 ppm zinc.
- The lead composition of claim 1, wherein the lead is in metal or oxide form, or in a mixture of forms.
 - 3. The lead composition of claim 2, wherein the lead is in metal form.
- 15 4. The lead composition of claim 2, wherein the lead is predominantly in the form of lead oxide.
 - 5. The lead composition of claim 1, wherein the silver, bismuth and zinc are each present in metal form, or as a compound with one or more other elements.
 - 6. The lead composition of claim 1, wherein the level of bismuth in the lead composition is between 250-700 ppm.
- 7. The lead composition of claim 1, wherein the level of bismuth in the lead composition is between 250-500 ppm.
 - 8. The lead composition of claim 1, wherein the level of zinc in the lead composition is between 250-700 ppm.
- The lead composition of claim 1, wherein the level of zinc in the lead composition is between 250-500 ppm.
 - 10. The lead composition of claim 1, wherein the level of silver is between 20-70ppm.
 - 11. The lead composition of claim 1, wherein the level of silver is between 20-66 ppm.

- 12. The lead composition of claim 1, wherein the lead composition comprises cadmium at a level of up to 1000 ppm.
- 5 13. The lead composition of claim 1, wherein the lead composition comprises cadmium at a level of 0-500 ppm.
 - 14. The lead composition of claim 12, wherein cadmium is present at a minimum level of 20 ppm.
- 15. The lead composition of claim 1, wherein the lead composition comprises tin at a level of 5-80 ppm.
- 16. The lead composition of claim 1, wherein the lead composition comprises not more than 10 ppm cobalt, 15 ppm chromium, 5 ppm manganese, 3 ppm selenium, 5 ppm tellurium, 250 ppm germanium, and 20 ppm thallium.
- 17. The lead composition of claim 1, wherein lead composition comprises not more than 10 ppm nickel, 10 ppm antimony, 20 ppm iron, 20 ppm copper and 20 ppm arsenic.
 - 18. The lead composition of claim 1, wherein the lead composition comprises not more than 2 ppm cobalt, 4 ppm chromium, 1.5 ppm manganese, 0.5 ppm selenium, 0.15 ppm tellurium, 10 ppm germanium, and 12 ppm thallium.
 - 19. The lead composition of claim 18, wherein the lead composition comprises not more than 2 ppm nickel, 2 ppm antimony, 5 ppm iron, 5 ppm copper and 4 ppm arsenic.
- 30 20. A lead composition comprising:
 - lead:

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silver, bismuth, zinc and tin in the following amounts:

- Ag 20-100 ppm
- Bi 250-1000 ppm
- Zn 250-1000 ppm
- Sn 5-80 ppm

and not more than the given amounts of the following elements measured in ppm:

	•	Ni	10
	•	Sb	10
	•	Co	10
	•	Cr	15
5	•	Fe	20
	•	Mn	5
	•	Cu	20
	•	Se	3
	•	Te	5
10	•	As	20
	•	Ge	250
	•	Tl	20
	•	Cd	1000.

15 21. The lead composition of claim 20, wherein the lead composition contains not more than the following amounts for at least 8 of the 13 elements set out in the following list:

2 Ni Sb 2 20 2 Co Cr 4 Fe 5 Mn 1.5 Cu 5 0.5 25 Se Te 0.15 4 As Ge 10 Tl 12 Cd700. 30

22. A lead composition comprising:

• lead;

silver, bismuth, zinc and tin in the following amounts:

Ag 20-70 ppm
 Bi 250-700 ppm
 Zn 250-700 ppm

Sn 5-40 ppm and not more than the given amounts of the following elements measured in ppm: Ni Sb 2 5 Co 2 Cr 4 Fe 5 Mn 1.5 Cu 5 10 Se 0.5 Te 0.15 As 4 Ge 10 Tl 12 15 Cd 700 23. The lead composition of claim 1, wherein the lead composition is in the form of a lead metal, a lead oxide powder, a lead-containing paste or a cured lead coating. 20 24. A battery plate comprising a coating of a lead composition, the lead ۶ composition comprising: lead 20-100 ppm silver 25 250-1000 ppm bismuth, and 250-1000 ppm zinc. 5 25. A battery plate comprising a coating formed from a lead composition comprising: 30 lead: silver, bismuth, zinc and tin in the following amounts: 20-100 ppm Ag Bi 250-1000 ppm Zn 250-1000 ppm 35 Sn 5-80 ppm and not more than the given amounts of the following elements measured in ppm:

Ni

		•	Sb	10
		•	Co	10
		•	Cr	15
		•	Fe	20
5		•	Mn	5
		•	Cu	20
		•	Se	3
		•	Te	5
		•	As	20
10		•	Ge	250
		•	Tl	20
		•	Cd	1000
	26.	Α	battery plat	e comprising a coating formed from a lead composition
15	comprising:			
		•	lead;	
	silver, bismut	h, z	inc and tin i	in the following amounts:
		•	Ag	20-70 ppm
		•	Bi	250-700 ppm
20		•	Zn	250-700 ppm
		•	Sn	5-40 ppm
	and not more	tha	n the given	amounts of the following elements measured in ppm:
		•	Ni	2
		•	Sb	2
25		•	Co	2
		•	Cr	4
		•	Fe	5
		•	Mn	1.5
		•	Cu	5
30		•	Se	0.5
		•	Te	0.15

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27. A battery comprising at least one battery plate with a coating of a lead

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700

As Ge

Tl

Cd

lead composition comprising:

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- lead
- 20-100 ppm silver
- 250-1000 ppm bismuth, and
- 250-1000 ppm zinc.
- 28. A battery comprising a battery case, electrolyte and at least two battery plates, wherein said battery plates are coated with a lead composition comprising
 - lead;
- silver, bismuth, zinc and tin in the following amounts:
 - Ag 20-100 ppm
 - Bi 250-1000 ppm
 - Zn 250-1000 ppm
 - Sn 5-80 ppm
- and not more than the given amounts of the following elements measured in ppm:
 - Ni 10
 - Sb 10
 - Co 10
 - Cr 15
 - Fe 20
 - Mn 5
 - Cu 20
 - Se 3
 - Te 5
 - As 20
 - Ge 250
 - T1 20
 - Cd 1000
- A battery comprising a battery case, electrolyte and at least two battery plates, wherein said battery plates are coated with a lead composition comprising
 - lead;

silver, bismuth, zinc and tin in the following amounts:

- Ag 20-70 ppm
- Bi 250-700 ppm
- Zn 250-700 ppm
- Sn 5-40 ppm

and not more than the given amounts of the following elements measured in ppm: Ni 2 Sb 2 5 Co 2 Cr 4 Fe 5 1.5 Mn Cu 5 10 Se 0.5 Te 0.15 4 As Ge 10 Tl 12 15 Cd 700 30. A lead composition for use in the production of positive battery plates 'n comprising: lead 20 100-1000 ppm antimony 100-1000 ppm iron. 31. The lead composition of claim 30, wherein the lead composition comprises less than 700 ppm zinc. 25 32. The lead composition of claim 30, wherein the lead composition comprises between 250-700 ppm bismuth and 250-700 ppm zinc. 33. A lead composition for use in the production of negative battery plates \ (30 comprising: lead 250-1000 ppm bismuth 250-1000 ppm zinc and

The lead composition of claim 33, wherein the level of bismuth is 250-

20-100 ppm silver,

and not more than 20 ppm antimony and not more than 30 ppm iron.

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700ppm, and the level of silver is 20-70ppm.

35. The lead composition of claim 33, wherein the level of antimony and iron in the lead composition is not more than 2 ppm antimony and 5 ppm iron.

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36. A lead composition for use in the production of pastes for positive battery plates comprising:

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- lead;
- 100-1000 ppm antimony
- 10 100-1000 ppm iron;

and not more than the given amounts of the following elements, measured in ppm:

- Bi 1000
- Zn 1000
- Cd 1000
- 15 Sn 80
 - Ni 10
 - Co 10
 - Cr 15
 - Mn 5

 - Cu 20 100
 - Ag
 - Se 3
 - 5 Te
 - As 20
 - Ge 250
 - Tl 20.
- 37. The lead composition of claim 36, wherein the lead composition comprises not more than the following amounts for at least 10 elements set out in the 30 following list:
 - Bi 700
 - Zn
 - Cd 500

700

- Sn 50
- Ni 2
- 2 Co
- Cr 4

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		•	Mn	1.5
		•	Cu	5
		•	Ag	66
		•	Se	0.5
5		•	Te	0.15
		•	As	4
		•	Ge	10
		•	Tl	12
_				
0				
	38.	A	lead com	position f

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38. A lead composition for use in the production of pastes for positive battery plates comprising:

- lead
- 100-1000 ppm antimony
- 100-1000 ppm iron

and not more than the given amounts of the following elements, measured in ppm:

- Bi 700
 Zn 700
 Cd 500
 Sn 50
 Ni 2
 Co 2
- Cr 4
- Mn 1.5
- Cu 5
 - Ag 66Se 0.5
 - Te 0.15
 - As 4
 - Ge 10
 - Tl 12.

39. A lead composition for use in the production of pastes for negative battery plates comprising:

• lead

• 250-1000 ppm Bi

• 250-1000 ppm Zn

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• 20-100 ppm Ag

and not more than the given amounts of the following elements measure in ppm:

- Sb 10
- Fe 20
- Sn 80
- Cd 1000
- Ni 10
- Co 10
- Cr 15
- 10 Mn 5

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- Cu 20
- Se 3
- Te 5
- As 20
- Ge 250
- Tl 20
- 40. The lead composition of claim 39, wherein the lead composition contains not more than the following amounts for at least 9 of the 14 elements set out in the following list:
 - Sb 2
 - Fe 5
 - Sn 50
 - Cd 500
 - Ni 2
 - Co 2
 - Cr 4
 - Mn 1.5
 - Cu 5
 - Se 0.5
 - Te 0.15
 - As 4
 - Ge 10
 - Tl 12

41. A lead composition for use in the production of pastes for negative battery plates comprising

		• lead					
	• 250-700 ppm Bi						
		• 250-1000 ppm Zn					
		• 40-66 ppr					
5	and not more	than the given	amounts of the following elements measure in ppm:				
		• Sb	2				
		• Fe	5				
		• Sn	50				
		• Cd	500				
10		• Ni	2				
		• Co	2				
		• Cr	4				
		• Mn	1.5				
		• Cu	5				
15		• Se	0.5				
		• Te	0.15				
		• As	4				
		• Ge	10				
		• Tl	12				
20							
	42.	A positive bat	ttery plate comprising a coating of a lead composition	15			
	comprising:						
		• lead					
		• 100-1000	ppm antimony				
25		• 100-1000	ppm iron				
				X i			
	43.	A positive bat	tery plate comprising a coating of a lead composition	•			
	comprising:						
		• lead					
30		• 100-1000	ppm antimony				
		• 100-1000	ppm iron				
	and not more	than the given	amounts of the following elements, measured in ppm:				
		• Bi	1000				
		• Zn	1000				
35		• Cd	1000				
		• Sn	80				
		• Ni	10				

	•	Co	10
	•	Cr	15
	•	Mn	5
	•	Cu	20
5	•	Ag	100
	•	Se	3
	•	Te	5
	•	As	20
	•	Ge	250
10	•	Tl	20.

44. A positive battery plate comprising a coating of a lead composition comprising:

- lead
- 15 100-1000 ppm antimony
 - 100-1000 ppm iron

and not more than the given amounts of the following elements, measured in ppm:

	•	Bi	700
	•	Zn	700
20	•	Cd	500
	•	Sn	50
	•	Ni	2
	•	Co	2
	•	Cr	4
25	•	Mn	1.5
	•	Cu	5
	•	Ag	66
	•	Se	0.5
	•	Te	0.15
30	•	As	4
	•	Ge	10

45. A negative battery plate comprising a coating of a lead composition comprising:

- 35
- lead

Tl

250-1000 ppm Bi

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• 250-1000 ppm Zn

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20-100 ppm Ag
      and not more than 20 ppm antimony and not more than 30 ppm iron.
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                    A negative battery plate comprising a coating of a lead composition
      46.
      comprising:
                       lead
                       250-1000 ppm Bi
                    • 250-1000 ppm Zn
10
                       20-100 ppm Ag
      and not more than the given amounts of the following elements measure in ppm:
                       Sb
                                  10
                                  20
                       Fe
                       Sn
                                  80
15
                       Cd
                                  1000
                       Ni
                                  10
                       Co
                                  10
                       Cr
                                 15
                       Mn
                                 5
20
                       Cu
                                 20
                       Se
                                 3
                                 5
                       Te
                       As
                                 20
                       Ge
                                 250
25
                       Tl
                                 20
      47.
                   A negative battery plate comprising a coating of a lead composition
      comprising:
                      lead
30
                       250-700 ppm Bi
                      250-1000 ppm Zn
                      40-66 ppm Ag
      and not more than the given amounts of the following elements measure in ppm:
                       Sb
                                 2
                                 5
35
                       Fe
                       Sn
                                 50
```

Cd

5		•		2 2 4 1.5 5 0.5 0.15 4
10		•	Tl	12
	48. comprising:	A 1	battery com	prising at least one positive plate with a coating
15		•		opm antimony
	11	•	100-1000 1	•
	and at least or	e no	egative plate lead	e with a coating comprising:
		•		opm bismuth
20		•	250-1000 p	
		•	20-100 ppi	•
	and not more	than	20 ppm an	timony and not more than 30 ppm iron.
25	49. comprising:	Αŀ	pattery comp	prising at least one positive plate with a coating
		•	lead	
		•	-	opm antimony
		•	100-1000 p	
30	and not more	inan	the given a Bi	mounts of the following elements, measured in ppm:
30		•	Zn	1000 1000
		•	Cd	1000
		•	Sn	80
		•	Ni	10
35		•	Co	10
		•	Cr	15

• Mn

•	Cu	20
•	Ag	100
•	Se	3
•	Te	5
•	As	20
•	Ge	250
•	Tl	20.

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and at least one negative plate with a coating comprising:

- lead;
- 250-1000 ppm Bi
 - 250-1000 ppm Zn
 - 20-100 ppm Ag

and not more than the given amounts of the following elements measure in ppm:

Sb 10 15 Fe 20 Sn 80 Cd 1000 Ni 10 Co 10 20 Cr 15 Mn 5 Cu 20 Se 3 Te 5

As

Ge

Tl

- 50. A method for monitoring the level of undesirable elements in a lead composition, comprising the steps of:
 - (e) selecting maximum acceptable levels for the elements cobalt, chromium, manganese, selenium, tellurium, germanium and thallium in a lead composition;
 - (f) testing the level of said elements in a lead composition;

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- evaluating the results of the test to determine whether the levels of the elements are within the selected maximum acceptable levels; and
 - (h) optionally modifying the lead composition to bring the level of any of the

elements that are outside the maximum acceptable levels within the maximum acceptable levels.

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- 51. The method of claim 50, wherein step (b) comprises testing the level of said elements using inductively coupled plasma atomic emission spectroscopy.
 - 52. The method of claim 50 further comprising the steps of
 - selecting the required levels or maximum acceptable levels of the elements tin, bismuth, zinc, cadmium, nickel, antimony, iron, copper, silver and arsenic in a lead composition;
 - testing the level of these elements;
 - evaluating the results of the test to determine whether the levels of the elements are within the required levels or maximum acceptable levels; and
- optionally modifying the lead composition to bring the level of any of the elements
 that are outside the required levels or maximum acceptable levels within these levels.

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Dated this 28th day of August 2003

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